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Plan for MEBT measurements in FY16

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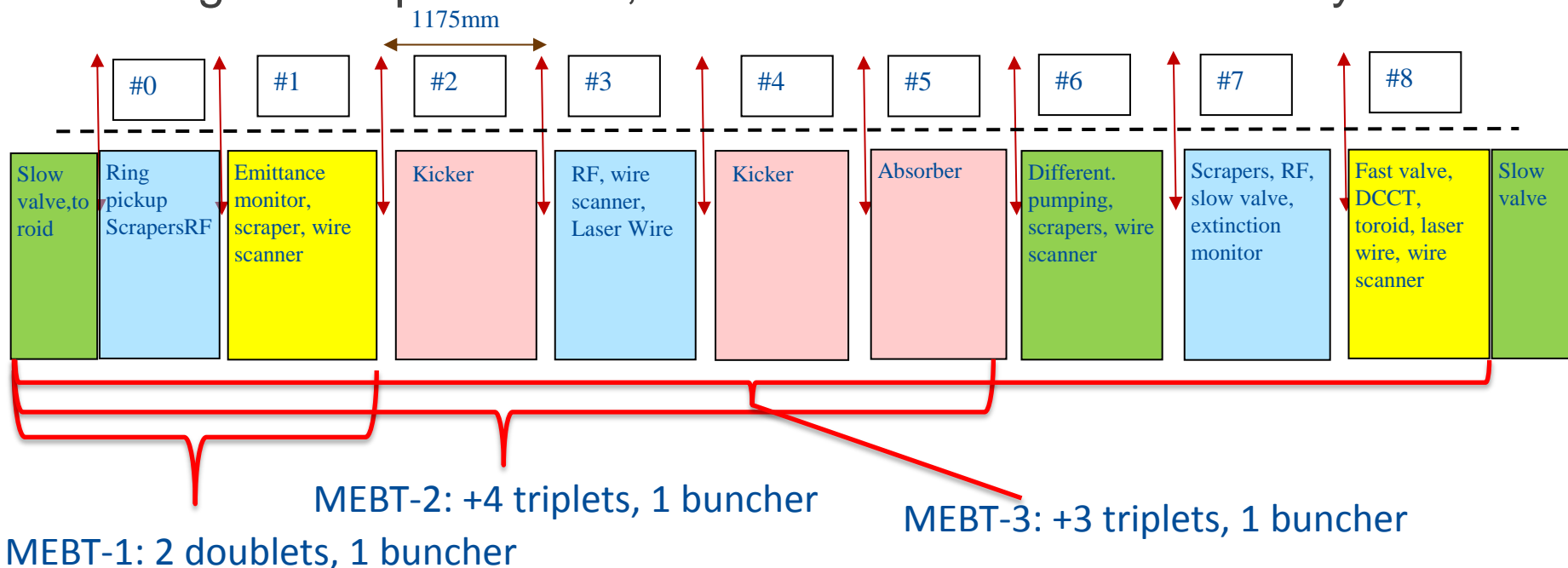
with inputs from C. Baffes and V. Scarpine

PIP-II technical meeting

October 27, 2015

MEBT stages

- The MEBT is proposed to be installed in several steps, determined mainly by arrival of magnets from BARC
 - MEBT -x, x=1, 2, 3 in this report corresponds to intermediate configurations with different number of magnets
 - Each configuration may have several variations of different diagnostics placement, which are referred as MEBT x-y



Assumptions for the plan

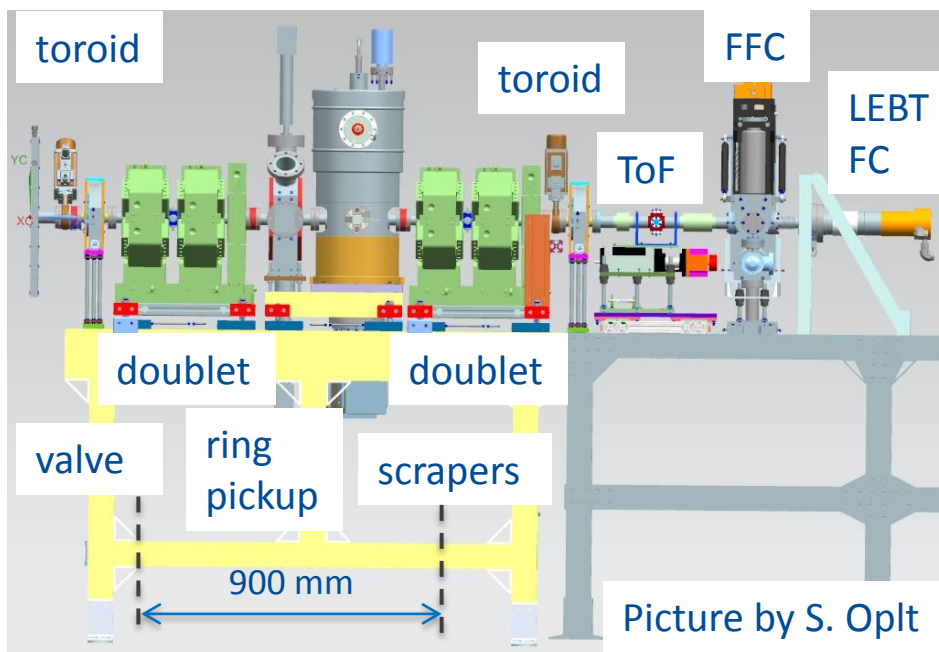
- Can start RFQ beam in pulse mode in Jan 2016
 - RFQ is RF- commissioned
 - MEBT 1-1 is ready to roll in
- No bad discoveries with beam and components
- Stop beam run in July 2016 for installation of MEBT-2
 - 4 triplets are supplied by BARC and one is re-measured in TD
 - One more bunching cavity is ready for installation
 - Kickers and additional diagnostics are ready
- In the case of further delays with RFQ, sacrifice the quantity of beam measurements for assembling MEBT-2 as soon as possible

Overall schedule

- Jan –Mar 2016 – 20 μ s beam in MEBT-1-1
 - Main goal: characterize the beam from RFQ
 - Commission all systems
- Apr- May-2016 – high-power beam in MEBT-1-2
 - Main goal: 10 kW (CW or long – pulse)
 - Test the absorber prototype with H-
- Jun-Jul 2016- emittance scanner measurements in MEBT 1-3
 - Main goal: transverse phase space reconstruction
 - Prepare to analyze effect of LEBT bend installation
- Jul-Sep 2016- shutdown to install MEBT-2
 - Install the LEBT bend at the same time
- Depending on progress on each stage, the list of elements in the following stages may be slightly adjusted

MEBT 1-1

- Jan 2016 – installation, Jan-Mar – MEBT 1-1 run
- Goals (beam – related)
 - Measure RFQ transmission and H- energy
 - Measure of transverse and longitudinal properties of a pulsed beam
 - Commission MPS
 - Characterize bunching cavity
- In parallel, a lot of instrumentation, LLRF and other efforts
- All beam line elements are fabricated
- **Need RFQ and bunching cavity phase-locked by mid-Jan**

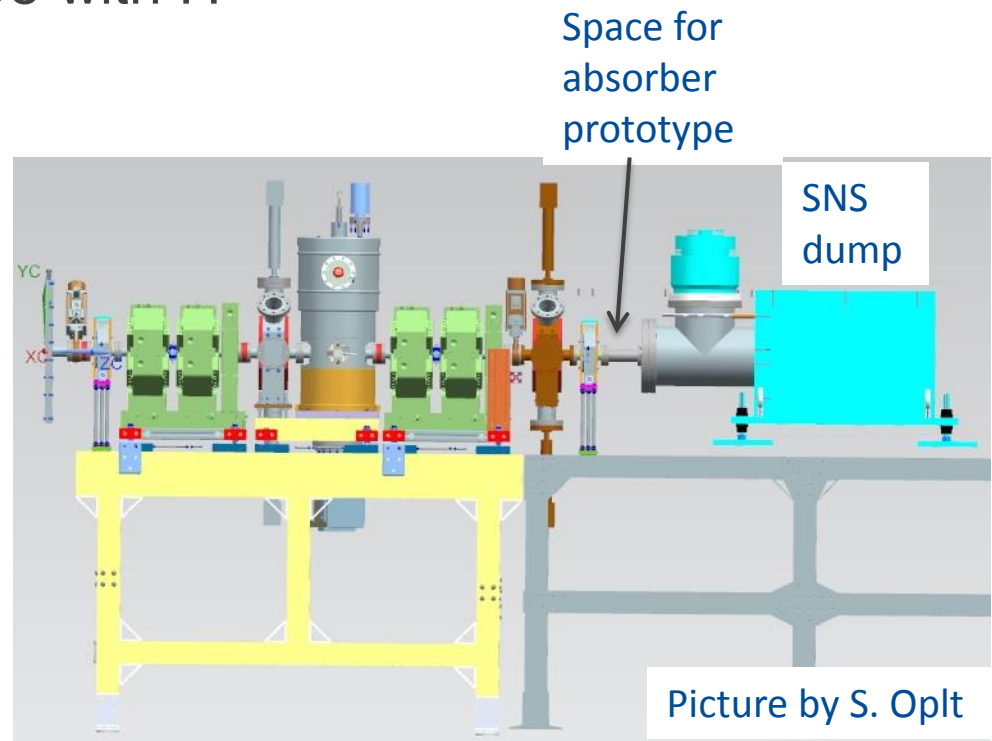


List of MEBT 1-1 beam measurements

- Beam current and losses (toroids, scrapers, Faraday Cup from LEBT)
- Machine Protection System (ring pickup etc.)
- Beam trajectory (BPMs)
- Energy (Time-of-Flight monitor, BPMs)
- Bunching cavity characterization (Fast Faraday Cup, ToF)
- Transverse optics (BPMs, scrapers, donut, quad scans)
- Longitudinal optics (FFC)
- Transverse tails (scrapers)
- RFQ/LEBT tuning
- **Need ring pickup, BPM, FFC electronics and software**
- Possibility to test diagnostics (Wire Scanner, Diamond)

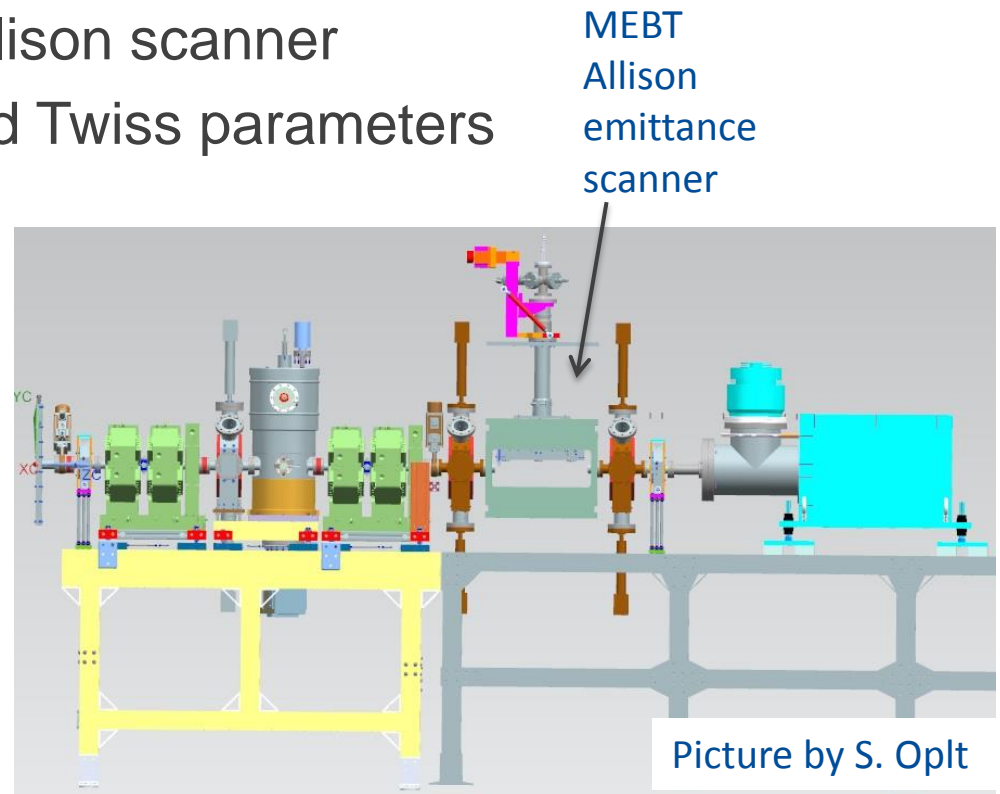
MEBT 1-2

- Mar 2016 – installation, Apr- May-2016 – MEBT-1-2 run
- Goal: test RFQ and MEBT in the high-power (CW) mode
 - Demonstrate 10 kW (average)
 - Test the absorber prototype with H-
- Measurements
 - CW beam scraping, MPS
 - beam tuning to fill the dump aperture
 - Irradiate the absorber prototype with ~ 5 kW H-
- Need to fabricate connections
- **Need RF amplifiers in CW**



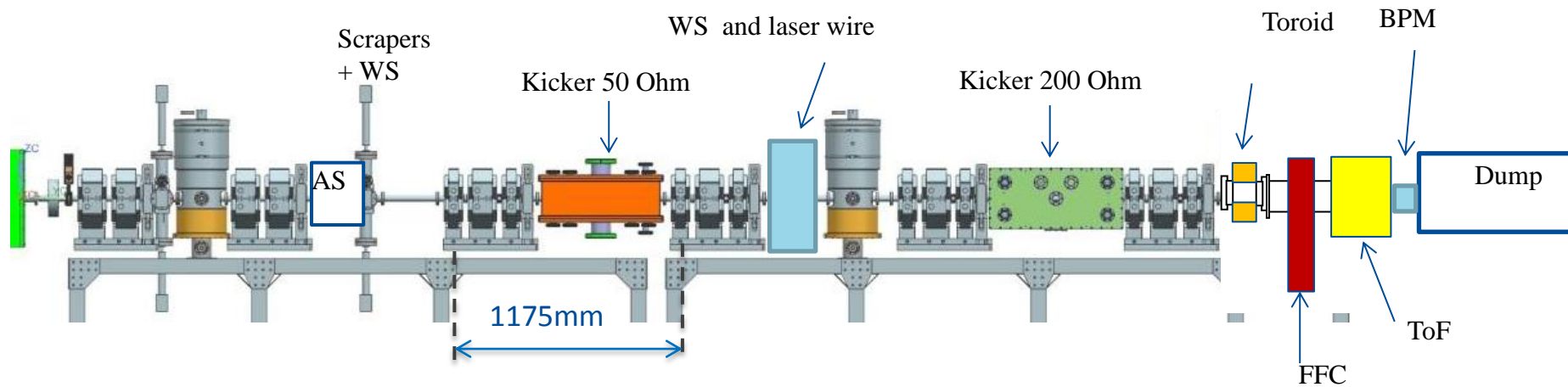
MEBT 1-3

- May 2016 – installation, Jun-Jul-2016 – MEBT-1-3 run
- Goal: transverse phase space reconstruction
- Measurements
 - Commission the MEBT Allison scanner
 - Measure phase space and Twiss parameters
 - Optimize LEBT/RFQ
- The Allison scanner needs to be designed, fabricated, and assembled



MEBT 2-1

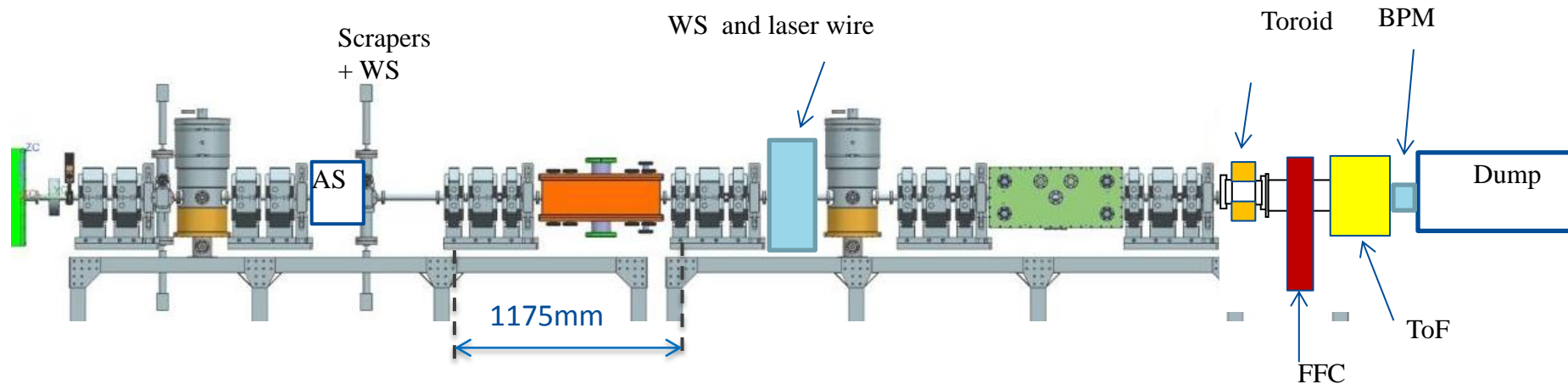
- Jul-Sep 2016- installation of MEBT 2-1 and LEBT bend
 - First two MEBT sections stay unchanged
 - Keep emittance scanner in the same position to understand possible changes due to the LEBT bend



- Add:
 - 4 triplets with BPMs, 1 bunching cavity, 2 kicker prototypes, +BPM
 - Assembly with Wire scanner and Laser wire with electron collection
- Design just started

MEBT-2 goals (FY17)

- Characterize transverse and longitudinal optics of the longer beam line, start experiments with laser wire and WCM
- Main goal: test and characterize kickers
 - First, separately, looking at the trajectory with BPMs
 - 50 Ohm powered by two 81.25 MHz CW amplifiers
 - 200 Ohm: two prototype 500V switches
 - Then, synch them and try to remove every other bunch



Possible scenario beyond FY16

- **Oct – Dec 2016** – MEBT-2 run
 - In the middle of the run, move the emittance scanner downstream and install Wall Current Monitor (MEBT 2-2)
 - Toward the end, install prototype absorber to try bunch-by-bunch separation (MEBT 2-3)
- **Jan- Feb 2017** – install MEBT-3 (full- length with prototypes)
- **Mar – Apr 2017** – MEBT-3 run
 - Characterize full beam line
 - First test of differential pumping
- **May - Nov 2017** – shutdown to install cryo, HWR, 10-MeV HEBT, and clean the MEBT downstream sections
- **Jan 2018** – beam through HWR